We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900
Open access books available

185,000
International authors and editors

200M
Downloads

Our authors are among the

154
Countries delivered to

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Chapter

Ocular Hypertension in Blacks

Daniel Laroche and Kara Rickford

Abstract

Ocular hypertension occurs when intraocular pressure (IOP) is greater than the normal range with no evidence of vision loss or damage to the optic nerve. Individuals with ocular hypertension have an increased risk for glaucoma. The mean normal IOP is 15 mmHg and the mean IOP of untreated glaucoma is 18 mmHg. Elevated IOP commonly occurs in patients over the age of 50 and is often due to enlargement of the lens, narrowing of the angle, iridolenticular apposition, and pigment liberation that obstructs the trabecular meshwork. Cataract surgery and lensectomy can lower IOP and reduce the risk of glaucoma. The global wealth inequality of Blacks has created health inequities that have led to decreased access to surgical care contributing to higher rates of blindness from glaucoma. Greater education on the benefits of early cataract surgery and trabecular bypass for higher risk patients, as well as addressing wealth and health inequities, can help to bend the curve of blindness from glaucoma.

Keywords: ocular hypertension, glaucoma, Blacks, cataract surgery, trabecular bypass, African-American

1. Introduction

Ocular hypertension occurs when the pressure in the eye (intraocular pressure or IOP) is beyond the normal value with no signs of vision loss or damage to the optic nerve [1]. With ocular hypertension, the aqueous humor (fluid produced by the eye) is poorly drained. The buildup of fluid in the eye leads to an increase in IOP that could potentially lead to damage of the optic nerve, causing glaucoma [2]. The mean normal IOP is 15 mmHg and the mean IOP of untreated glaucoma is 18 mm Hg [1]. Ocular hypertension typically presents with no signs or symptoms, making it difficult to detect without access to an eye exam. Individuals with elevated IOP may be treated with cataract surgery and lensectomy [2, 3]. To properly address populations at risk for ocular hypertension, it is advantageous to determine how demographic variables may impact an individual's susceptibility to blindness. Demographic variables are innate or non-changeable determinants of a disease. Addressing inequities in wealth, health, and access to medical care, as well as improved education on the benefits of early surgical intervention, can bend the curve of blindness from glaucoma. In this chapter, we use epidemiologic studies focusing specifically on Blacks to describe the prevalence and management of ocular hypertension.

2. Prevalence of ocular hypertension in blacks

In 2019, Black Americans made up 12.8% of US population, accounting for over 42 million people [4]. Although Blacks make up a minority of the population, many

eye diseases, including ocular hypertension and glaucoma, affect a disproportionate number of Blacks, leading to higher rates of vision loss than documented in white-Americans [5]. Definitions of race and ethnicity have been ill-defined in past medical literature, with many overlaps. Therefore, the term "Blacks" in this context refers to an individual of black African descent. The population of Blacks in the Caribbean is over 21 million and in Africa is close to one billion [6]. There are also issues of decreased access to surgery in both locations [7].

While it has been universally accepted and documented that Blacks have higher prevalence of ocular hypertension, the degree of prevalence may differ for varying black populations. For example, the black-American and black-Caribbean populations studied in the Baltimore Eye Survey and the Barbados Eye Study, respectively, are ethnically unique. Both populations of Blacks presented with a high prevalence of ocular hypertension, but to a different degree. The prevalence of ocular hypertension in the black-Caribbean population was reported at levels nearly twice that of the black-American population [8–11]. Studies have also reported a notably higher prevalence of ocular hypertension in Blacks in comparison to other racial groups (primarily white) [12, 13].

In response to a lack of substantial ocular research with Black study participants, extensive population-based studies including the Baltimore Eye Survey [9], The Ocular Hypertension Treatment Study [2], The Barbados Eye Study [8], and the African American Eye Disease Study [13] were created to address the disproportionate prevalence of eye diseases present in Blacks. Further studies are needed to continue to build upon this body of research, particularly to look at earlier interventions of cataract surgery and trabecular bypass as an earlier intervention to prevent glaucoma.

3. Mechanism of ocular hypertension in blacks

Studies have shown that with age the crystalline lens increases in width. During accommodation, the iris bows posteriorly. With age there is increased contact between the posterior iris pigment epithelium and lens zonules leading to pigment liberation and obstruction of the trabecular meshwork [14]. This is often seen with heavier pigment in the trabecular meshwork inferiorly compared to superiorly on gonioscopy [15]. The increased width of the lens can also lead to pupillary block and iris obstruction of the trabecular meshwork leading to elevated intraocular pressure. This common mechanism of ocular hypertension in persons over the age of 50 is often overlooked by physicians. Current physicians and those in training must be better educated to look for this clinically and intervene promptly. Early cataract surgery and lensectomy is beneficial to remove the large lens and trabecular bypass to restore aqueous outflow via the obstructed trabecular meshwork [14].

4. Genetic influence on ocular hypertension

Previous studies have shown intraocular pressure (IOP) to be highly heritable, indicating possible genetic influence on the development of ocular hypertension [12, 16]. There is additional substantial evidence suggesting that ocular hypertension leading to glaucoma may have a genetic component [17], but the specific genetic risk factors have not yet been identified. A 2012 genome wide association study conducted in 11,972 participants from The Netherlands, UK, Australia, and Canada investigated candidate genes in human ocular tissue to identify susceptibility to elevated IOP and glaucoma [12]. Elevated IOP commonly occurs in patients

over the age of 50 and often presents with enlargement of the lens, narrowing of the angle, iridolenticular apposition, or pigment liberation that obstructs the trabecular meshwork. Genes regulating these ocular components were studied and the results revealed that genetic variants expressed in genes GAS7 and TMCO1 were associated with changes in IOP in the populations studied. Both revealed only marginal evidence for ocular hypertension, as GAS7 was associated with a 0.19 mmHg decrease in IOP and TMCO1 was associated with a 0.28 mmHg increase in IOP [12]. Additional findings revealed that individuals of European ancestry expressed the GAS7 variant at 0.44 frequency while those of African ancestry expressed the same variant at 0.12 frequency [12]. The lower frequency of this variant in Blacks may reflect the elevated IOP common in individuals of African descent and requires further research.

While impressive strives have been made over the past two decades to identify genetic components of ocular diseases [18], a comprehensive understanding of the pathophysiology has frequently been limited to individuals of European and Asian ancestry, requiring an increased need for genetic research in Blacks and other understudied populations. For example, multiple genetic variants in genes associated with elevated IOP were discovered in non-Black populations and a majority do not replicate, nor have an effect, in Blacks [19–21]. In response to an increased need for the identification of genetic risk factors that underlie elevated IOP in the understudied population of Blacks, the Primary Open-Angle African American Glaucoma Genetics (POAAGG) study was created in 2014 and took place over the course of five years to address these research disparities [22]. This study identified a genetic variation known as a single nucleotide polymorphism (SNP) involved in the homeostasis of the trabecular meshwork [23]. The trabecular meshwork (TM) is located in the anterior portion of the eye and regulates the outflow of the aqueous humor into circulation [24]. If resistance increases in the TM during aqueous humor outflow, intraocular pressure may rise leading to ocular hypertension. By identifying a genetic variant that may affect the TM in Blacks, the POAAGG study has made a pertinent finding to our understanding of the role of genetics in ocular hypertension and glaucoma. As one of the first large cohort studies with over 5,000 study participants, additional analyses are needed to further validate the implications of this study.

In addition, the progression of elevated IOP in Blacks leading to ocular hypertension is likely a combination of genetic, environmental, aging and socioeconomic factors, as well as others not mentioned. These demographic variables will continue to be explored throughout this chapter.

4.1 Central corneal thickness in ocular hypertension

Intraocular pressure is routinely measured in clinical practice to assess various conditions within the eye, including that of the optic nerve and visual field [25]. Goldmann applanation tonometry is the most common technique used to measure IOP, but its accuracy and use as a diagnostic tool may be impeded by the rigidity of the cornea [25]. A thicker cornea may cause an overestimate of IOP and a thinner cornea may cause an underestimate of IOP. The consensus on the necessity to correct IOP based on central corneal thickness is not yet clear. While CCT is statistically significant as a predictor of glaucoma development [2], it does not present as an independent risk factor [26].

The Ocular Hypertension Treatment Study (OHTS) and the European Glaucoma Prevention Study (EGPS) recognized central corneal thickness as one of the most significant predictors for primary open-angle glaucoma [2, 27]. The mean central corneal thickness is about 560 μ m and the risk for developing ocular hypertension

has been reported to nearly double (hazard ratio of 1.82) for every 40 μm decrease [28]. Patients with thin corneas (<555 μm) [2] may present with an underestimated IOP reading, placing the individual at potential risk if actual IOP is elevated. The primary diagnostic criteria for ocular hypertension is IOP, so any factor that hinders this measurement may lead to an errant diagnosis. Patients with ocular hypertension typically present with thicker corneas, which may lead to an overestimation of IOP, while primary open angle glaucoma patients present with thinner corneas [29]. While the influence of elevated IOP on central corneal thickness has not yet been determined, individuals whose IOPs have been reduced pharmacologically by at least 20% demonstrated no change in corneal thickness [30].

Differences in central corneal thickness were noted between black Americans and white Americans. In the OHTS, Blacks were found to have thinner central corneal thickness (555.7 μm), resulting in lower applanation readings and a miscalculated estimation of the true level of IOP [30]. The South African Eye Study [31] also measured differences in central corneal thickness and compared the findings to measurements of intraocular pressure in Blacks, mixed ethnicity peoples, and whites. The findings revealed that Blacks had the thinnest corneas and highest IOP, followed by mixed ethnicity then white individuals.

These results suggest the possible need for refining the risk factor definitions when measuring central corneal thickness and IOP in varying populations. While obtaining a central corneal thickness measurements for all patients may not be necessary, patients with ocular hypertension should continue to be monitored to measure accurate IOP and determine possible susceptibility to glaucoma.

4.2 Morphological changes in the retinal nerve fiber layer in ocular hypertension

Differing from glaucoma, ocular hypertension presents with a normal optic nerve and no signs of damage. Ocular hypertension is often a precursor to glaucoma as abnormally high pressures in the eye may lead to damage of the optic nerve causing vision loss or blindness [1]. Studies have indicated differences in the structure of the optic nerve between Blacks and whites [32–33]. The optic disc area was 12% larger in Blacks compared to Whites [32]. The larger optic nerve may cause a greater strain at similar pressure levels, but it is not clear if larger optic discs affect one's susceptibility to ocular hypertension as there are incongruous reports [10, 34]. The impact of these differences has been postulated to affect the increased susceptibility of Blacks to ocular hypertension and glaucoma.

The retinal nerve fiber layer (RNFL) is primarily comprised of retinal ganglion cell axons that progressively diminish in glaucoma. As a result, the RNFL thins considerably and may present as an early manifestation of glaucoma [35]. As a precursor to glaucoma, RNFL was measured in patients with ocular hypertension and the results revealed a significant thinning of RNFL of about 15% in ocular hypertensive eyes as compared to normal eyes [36]. Other studies have yet to demonstrate significant differences RNFL between normal eyes and those with ocular hypertension, possibly due to the sensitivity of the instruments used to measure and the study population [36, 37].

5. Inequities contributing to ocular hypertension in blacks

Vision loss is a pertinent public health challenge that requires the efforts of many to overcome [38, 39]. Addressing these disparities involves contending with the

pervasive economic and racial inequalities that have had a disproportionate impact on Blacks, particularly in healthcare utilization. These inequities are evident in a 2020 study documenting the recency of eye examinations among black adults over the age of 55 [40]. In this study, 13.4% of participants (n = 740) reported having no eye examination in the last five years and nearly 25% had not had an eye exam in the last year [40]. Concerningly, 20% of study participants with diabetes mellitus were not instructed by other healthcare providers to seek annual eye examinations.

5.1 Health and wealth inequities in blacks

Systemic and social inequities have resulted in poor health outcomes in Blacks [41]. When examining wealth in the United States, there is countless evidence of extensive racial disparities. In 2016, the net worth of the average white family in the US was nearly ten times more than that of a Black family at $171,000 and $17,150 respectively [42]. These extensive differences in wealth and income reflect the consequences of years of discrimination, segregation, and inequality that mark the history of the US from its inception. The wealth gap between Blacks and whites in the US demonstrates the differences in opportunity afforded to citizens [42]. Colonialism has contributed to similar wealth disparities in the Caribbean and Africa. Differing from the circumstances in developing countries, the eye health care system in the United States is highly capable of delivering the care necessary to treat patients [41, 43]. However, much improvement is needed in the means by which education is delivered to the public and effective screening may take place.

The history of medicine and health care in the United States is tainted by a myriad of forms of injustice and violence towards Blacks that includes segregation of medical facilities, unequal healthcare access, and disdainful medical experimentation [44, 45]. Today, these inequalities are especially evident in employment, housing, and wealth opportunities in medically underserved areas and populations (MUA/P) [46–48]. MUA/P have been defined by the Health Resources and Services Administration as areas or populations having too few health care providers, high poverty or high elderly populations [49]. In addition, there are also social factors that have had strong implications on the health outcomes of Blacks, particularly poverty, food insecurity, and affordable housing. Low-socioeconomic status and race have been independently associated with increased vision loss placing poor Blacks at an increased risk [47]. These social factors that have often led to poor health outcomes in Blacks are rooted in racism and implicit biases that have to be recognized and changed at the personal, medical, and institutional level in order to lead to change [50].

Many studies have reported the association between visual impairment and poor quality of life, as well as physical and mental illness [51–53]. Unilateral and bilateral vision loss and blindness can impact a person's quality of life by affecting their ability to read, walk, commute, and carry out daily activities [54]. In addition to the disparities previously mentioned, blindness can exasperate the inequities faced by Blacks in the US. Early treatment of ocular hypertension by reducing elevated IOP by 20% can reduce the risk of developing glaucoma in half [2], thereby reducing the risk of blindness. Earlier cataract surgery, clear lensectomy, and trabecular bypass may reduce it even more. Implementing measures to address ocular hypertension in Blacks can help reduce the risk of blindness and address health inequities in the medical community. In addition, public policy is needed to develop models of healthcare that make services more accessible, particularly in communities that are medically underserved.

5.2 Insurance and access to care

Access to health care can impact one's health outcomes. The utilization of healthcare may be determined by whether people know care is needed, whether obtaining care is wanted, and whether care can be accessed [55]. Access is often used to describe the ease of obtaining care, including its availability, the accommodations provided, and affordability. Health care in the United States often cannot be utilized without insurance, regardless of the presence of a healthcare provider that is geographically accessible. The public health challenge regarding ocular hypertension is that if the elevated IOP was detected earlier on, further exasperation of the condition could be slowed and potential diseases could be prevented [56, 57]. With newer surgical approaches progression can be halted with earlier cataract surgery/clear lensectomy and trabecular bypass.

Successful treatments for elevated IOP have included topical medications, surgery, or laser [58]. Reducing IOP significantly may lead to a delay in progression to optic nerve damage, visual field loss, or glaucoma [59]. Several studies have reported the impact of lack of medical care on health outcomes [60, 61]. The Salisbury Eye Evaluation Study [62] was a population-based study that sought to investigate the causes of blindness and visual impairments of adults between the ages of 65 and 84. The study revealed higher levels of blindness and visual impairments in Blacks compared to whites, with 37% of the conditions classified as surgically treatable and 44% categorized as targets for low vision remediation. The study was not able to identify patients whose eye condition was amenable and chose not to undergo surgery for reasons including financial barriers, fear of the surgical procedure, or absence of functional loss. It is important to encourage all patients, particularly those with ocular hypertension, to seek continuous to monitor their condition.

The Affordable Care Act (ACA) was enacted in March 2010 with its primary goals being to make affordable health insurance available to more people and to generally lower the cost of health care [63]. Better health outcomes in Blacks have been linked to increases in health insurance coverage under the ACA [64]. While uninsured rates were reduced, Black Americans remained 1.5 times more likely to be uninsured than non-Hispanic white Americans [65]. Additionally, data gained from the National Health Interview Survey conducted between 2014–2016 revealed that access and utilization of eye care is lower among racial and ethnic minorities [66]. Increased access to health care and affordable insurance may improve the health outcomes of vulnerable populations with ocular hypertension.

6. Patient education for ocular hypertension

Patient education is an interactive process in which learning may take place between the healthcare provider and the patient. Increased patient education of vision health may lead to an increasing trend of eye doctor visits. Previous studies have reported that those with more education are more likely to seek care from an eye care professional as opposed to those with less education [67]. As a result of ocular hypertension, many Black patients were reported to present to an ophthalmologist with more extensive damage to the optic nerve as compared to whites [68]. As a result, the disease progression in Blacks was more vulnerable to malignancy even after intervention is initiated. Safer earlier cataract surgery and trabecular bypass are important treatment options that should be offered earlier.

Educating patients on ocular hypertension involves sharing the risk factors associated with the eye condition such as family history, age, medical conditions, and

past eye injuries, as well prevention and treatment options. Due to the asymptomatic presentation of ocular hypertension with no signs of vision loss, it is possible that patients have not/will not seek treatment until further damage and vision loss occur. Prior recorded interactions between physicians and patients have found that providers were less likely to educate Black patients about glaucoma and were also less likely to educate patients of lower health literacy about glaucoma medications [69]. It is important for the patient's eye health that ocular hypertension and its potential progression to glaucoma are described and apprehensible, particularly to those in populations most at risk. Through patient education of ocular hypertension, the patient may better understand their susceptibility to eye disease and can seek early treatment if necessary.

7. Prevention and implementation of changes to address ocular hypertension in blacks

Given the information presented in this chapter, initiation of treatment for ocular hypertension may be started earlier in Blacks with the possibility of arresting or reducing elevated IOP. The aging population of adults aged 65 and older is continuously increasing with expectation of this number to reach nearly 90 million in the US by 2050 [70]. In addition, growing levels of obesity increasing the prevalence of diabetes make an increasing number of individuals at risk for vision loss in the future. As the risk factors for ocular hypertension increase, recognition of patient vulnerabilities and systemic level changes are needed to ensure that the needs of patients are properly and conveniently addressed.

8. Conclusion

This chapter has demonstrated the unique demographic and ocular characteristics that have affected Blacks in the progression of ocular hypertension. The combination of race, socioeconomic status, and access to treatment may influence the diagnosis and health outcome of individuals with ocular hypertension. Acknowledging these factors and implementing changes to promote early diagnosis and treatment, as well as addressing health and wealth disparities in high-risk populations, can lead to lower rates of glaucoma and blindness. Physician advice through patient education, as well as affordability, continuity, and frequent access to care has demonstrated a strong association with increased eye care services [71]. Diagnosis and early intervention of elevated levels of intraocular pressure and ocular hypertension may reduce the risk of glaucoma, vision loss, and blindness in future patients.

Conflict of interest

The authors declare no conflict of interest.

IntechOpen

IntechOpen

Author details

Daniel Laroche[1*] and Kara Rickford[2]

1 New York Eye and Ear Infirmary, Icahn School of Medicine of Mount Sinai, New York, NY, USA

2 School of Medicine, New York Medical College, Valhalla, NY, USA

*Address all correspondence to: dlarochemd@aol.com

IntechOpen

© 2021 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/3.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. CC BY

References

[1] Sommer, A. Glaucoma: Facts and fancies. Eye 1996;10 295-301.

[2] Kass M, Heuer D, Higginbotham EJ, et al. The Ocular Hypertension Treatment Study: a randomized trail determines that topical ocular hypotensive medication delays or prevents the onset of primary open angle glaucoma. Archives of Ophthalmology. 2002;120 701-713.

[3] The Advanced Glaucoma Intervention Study (AGIS): 7. The relationship between control of intraocular pressure and visual field deterioration. American journal of ophthalmology. 2000;130 429-440.

[4] United States Census Bureau. Race and Ethnicity [Internet] 2019. Available from: https://data.census.gov/cedsci/profile?q=United%20States&g=0100000US [Accessed 2021-01-28]

[5] National Eye Institute. Eye Health Among African Americans. [Internet] 2019. Available from https://www.nei.nih.gov/learn-about-eye-health/resources-for-health-educators/eye-health-among-african-americans [Accessed 2021-01-28]

[6] The World Bank. Countries and Economies Data [Internet] 2020. Available from https://data.worldbank.org/country [Accessed 2021-02-07]

[7] World Health Organization. Eye Health [Internet] 2020. Available from https://www.afro.who.int/health-topics/eye-health#:~:text=Approximately%2026.3%20million%20people%20in,blind%20population%20reside%20in%20Africa. [Accessed 2021-02-07]

[8] Leske M, Connell A, Schachat A, Hyman L. The Barbados Eye Study. Prevalence of open angle glaucoma. Archives of Ophthalmology. 1994;112(6):821-829. DOI: 10.1001/archopht.1994.01090180121046

[9] Tielsch JM, Katz J, Singh K, et al. A population-based evaluation of glaucoma screening: the Baltimore Eye Survey. American Journal of Epidemiology. 1991;134(10):1102-1110. DOI: 10.1093/oxfordjournals.aje.a116013

[10] Wilson M, Gallardo M. Glaucoma Risk Factors: Ethnicity and Glaucoma. In: Schacknow P, Samples J, editors. The Glaucoma Book. 1st ed. New York: Springer; 2010. p. 101-107.

[11] Friedman D, Wilson M, Liebmanm J, et al. An evidence-based assessment of risk factors for the progression of ocular hypertension and glaucoma. American Journal of Ophthalmology. 2004;138(3):19-31. DOI: 10.1016/j.ajo.2004.04.058

[12] van Koolwijk LM, Ramdas WD, Ikram MK, et al. Common genetic determinants of intraocular pressure and primary open-angle glaucoma. PLoS Genetics. 2012;8(5):e1002611. DOI: 10.1371/journal.pgen.1002611

[13] McKean-Cowdin R, Fairbrother-Crisp A, Torres M, Lastra C, et al.The African American Eye Disease Study: Design and Methods. Ophthalmic Epidemiology. 2018;25(4):306-314. DOI: 10.1080/09286586.2018.1454965

[14] Laroche D, Nkrumah G, Ng C. Real-world efficacy of the Hydrus microstent in Black and Afro-Latinx patients with glaucoma: a retrospective study. Therapeutic Advances in Ophthalmology. 2020;12:2515841420964311. DOI: 10.1177/2515841420964311.

[15] Lahola-Chomiak AA, Walter MA. Molecular Genetics of Pigment Dispersion Syndrome

and Pigmentary Glaucoma: New Insights into Mechanisms. Journal of Ophthalmology. 2018;2018:5926906. DOI: 10.1155/2018/5926906.

[16] Jiao X, Yang Z, Yang X, et al. Common variants on chromosome 2 and risk of primary open-angle glaucoma in the Afro-Caribbean population of Barbados. Proceedings. 2009;106(40):17105-10. DOI: 10.1073/pnas.0907564106

[17] Chan C, Wiggs J, Sobrin L. The Genetic Influence on Corticosteroid-Induced Ocular Hypertension: A Field Positioned for Discovery. American Journal of Ophthalmology. 2019;202:1-5. DOI: 10.1016/j.ajo.2019.02.001

[18] Choquet H, Paylakhi S, Kneeland S, et al. A multiethnic genome-wide association study of primary open-angle glaucoma identifies novel risk loci. Nature Communications 2018;9:2278. DOI: 10.1038/s41467-018-04555-4

[19] Burdon KP, Macgregor S, Hewitt AW, et al. Genome-wide association study identifies susceptibility loci for open angle glaucoma at TMCO1 and CDKN2B-AS1. Nature Genetics. 2011;43(6):574-8. DOI: 10.1038/ng.824.

[20] Vithana EN, Khor CC, Qiao C, et al. Genome-wide association analyses identify three new susceptibility loci for primary angle closure glaucoma. Nature Genetics. 2012t;44(10):1142-1146. DOI: 10.1038/ng.2390.

[21] Masakazu N, Yoko I, Takazumi T, et al. Three susceptible loci associated with primary open-angle glaucoma identified by genome-wide association study in a Japanese population. 2009;106(31):12838-12842. DOI: 10.1073/pnas.0906397106

[22] Khachatryan N, Pistilli M, Maguire MG, et al. Primary Open-Angle African American Glaucoma Genetics (POAAGG) Study: gender and risk of POAG in African Americans. PLoS One. 2019;14(8):e0218804. DOI: 10.1371/journal.pone.0218804.

[23] Gudiseva H, Verma S, Chavali V, et al. Genome wide-association study identifies novel loci in the Primary Open-Angle African American Glaucoma Genetics (POAAGG) study. DOI 10.1101/2020.02.27.968156

[24] Vranka JA, Kelley MJ, Acott TS, Keller KE. Extracellular matrix in the trabecular meshwork: intraocular pressure regulation and dysregulation in glaucoma. Experimental Eye Research. 2015;133:112-25. DOI: 10.1016/j.exer.2014.07.014.

[25] Ventura A, Bohnke M, Mojon D. Central corneal thickness measurements in patients with normal tension glaucoma, primary open angle glaucoma, pseudoexfoliation glaucoma, or ocular hypertension. British Journal of Ophthalmology. 2001;85:792-795.

[26] Medeiros FA, Weinreb RN. Is corneal thickness an independent risk factor for glaucoma? Ophthalmology. 2012;119(3):435-6. DOI: 10.1016/j.ophtha.2012.01.018.

[27] Miglior S, Zeyen T, Pfeiffer N, et al. European Glaucoma Prevention Study (EGPS) Group. Results of the European Glaucoma Prevention Study. Ophthalmology. 2005;112(3):366-75. DOI: 10.1016/j.ophtha.2004.11.030.

[28] Gordon M, Torri V, Miglior S, et al. Validated prediction model for the development of primary open-angle glaucoma in individuals with ocular hypertension. Ophthalmology. 2007;114(1):10-9. DOI: 10.1016/j.ophtha.2006.08.031.

[29] Copt R, Thomas R, Memoud A. Corneal Thickness in Ocular Hypertension, Primary Open-angle Glaucoma, and Normal Tension

Glaucoma. Archives of Ophthalmology. 1999;117(1):14-16. DOI: 10.1001/archopht.117.1.14

[30] Herman D, Hodge D, Bourne W. Increased Corneal Thickness in Patients With Ocular Hypertension. Archives of Ophthalmology. 2001;119(3):334-336. DOI:10.1001/archopht.119.3.334

[31] Baboolal SO, Smit DP. South African Eye Study (SAES): ethnic differences in central corneal thickness and intraocular pressure. Eye (Lond). 2018;32(4):749-756. DOI: 10.1038/eye.2017.291.

[32] Girkin CA. Differences in optic nerve structure between individuals of predominantly African and European ancestry: Implications for disease detection and pathogenesis. Clinical Ophthalmology. 2008;2(1):65-9. doi: 10.2147/opth.s1628.

[33] Varma R, Tielsch JM, Quigley HA, Hilton SC, Katz J, Spaeth GL, Sommer A. Race-, age-, gender-, and refractive error-related differences in the normal optic disc. Archives of Ophthalmology. 1994;112(8):1068-76. doi: 10.1001/archopht.1994.01090200074026.

[34] Chi T, Ritch R, Stickler D, Pitman B, Tsai C, Hsieh FY. Racial differences in optic nerve head parameters. Archives of Ophthalmology. 1989;107(6):836-9. DOI: 10.1001/archopht.1989.01070010858029.

[35] Fortune B, Cull G, Reynaud J, Wang L, Burgoyne CF. Relating Retinal Ganglion Cell Function and Retinal Nerve Fiber Layer (RNFL) Retardance to Progressive Loss of RNFL Thickness and Optic Nerve Axons in Experimental Glaucoma. Investigative Ophthalmology & Visual Science. 2015;56(6):3936-44. doi: 10.1167/iovs.15-16548.

[36] Bowd C, Weinreb R, Williams J, et al. The Retinal Nerve Fiber Layer Thickness in Ocular Hypertensive, Normal, and Glaucomatous Eyes With Optical Coherence Tomography. Archives of Ophthalmology. 2000;118(1):22-26. doi:10.1001/archopht.118.1.22

[37] Zangwill L, van Horn S, De Souza M, et al. Optic Nerve Head Topography in Ocular Hypertensive Eyes Using Confocal Scanning Laser Ophthalmoscopy. American Journal of Ophthalmology. 1996;122(4):520-525.

[38] The International Agency for the Prevention of Blindness. Vision 2020 [Internet] 2020. Available from: https://www.iapb.org/about/vision-2020/ [Accessed 02-01-2021]

[39] Azuara-Blanco A, Burr J, Ramsay C, et al. Effectiveness of early lens extraction for the treatment of primary angle-closure glaucoma (EAGLE): a randomised controlled trial. Lancet. 2016;388(10052):1389-1397. DOI: 10.1016/S0140-6736(16)30956-4.

[40] Bazargan M, Ekwegh T, Cobb S, Adinkrah E, Assari S. Eye Examination Recency among African American Older Adults with Chronic Medical Conditions. Healthcare (Basel). 2020;8(2):94. DOI: 10.3390/healthcare8020094.

[41] The Century Foundation. Racism, Inequality, and Health Care for African Americans [Internet] 2019. Available from: https://tcf.org/content/report/racism-inequality-health-care-african-americans/?session=1&session=1 [Accessed 02-01-2021]

[42] Brookings. Examining the Black-white wealth gap [Internet] 2020. Available from: https://www.brookings.edu/blog/up-front/2020/02/27/examining-the-black-white-wealth-gap/ [Accessed 02-07-2021]

[43] American Academy of Ophthalmology. Eye Health Statistics

[Internet] 2021. Available from: https://www.aao.org/newsroom/eye-health-statistics [Accessed 02-01-2021]

[44] Sarrazin MS, Campbell ME, Richardson KK, Rosenthal GE. Racial segregation and disparities in health care delivery: conceptual model and empirical assessment. Health Services Research. 2009;44(4):1424-44. DOI: 10.1111/j.1475-6773.2009.00977

[45] Scharff DP, Mathews KJ, Jackson P, Hoffsuemmer J, Martin E, Edwards D. More than Tuskegee: understanding mistrust about research participation. Journal of Health Care for the Poor and Underserved. 2010;21(3):879-97. DOI: 10.1353/hpu.0.0323.

[46] Nuriddin A, Mooney G, White AIR. Reckoning with histories of medical racism and violence in the USA. Lancet. 2020;396(10256):949-951. DOI: 10.1016/S0140-6736(20)32032-8.

[47] American Bar Association. The Impact of Structural Racism in Employment and Wages on Minority Women's Health [Internet] 2018. Available from: https://www.americanbar.org/groups/crsj/publications/human_rights_magazine_home/the-state-of-healthcare-in-the-united-states/minority-womens-health/ [Accessed 02-01-2021]

[48] The Federal Reserve System. Disparities in Wealth by Race and Ethnicity in the 2019 Survey of Consumer Finances [Internet] 2020. Available from: https://www.federalreserve.gov/econres/notes/feds-notes/disparities-in-wealth-by-race-and-ethnicity-in-the-2019-survey-of-consumer-finances-20200928.htm [Accessed 02-01-2021]

[49] Health Resources & Services Administration. MUA Find [Internet] 2021. Available from: https://data.hrsa.gov/tools/shortage-area/mua-find#:~:text=Medically%20Underserved%20Areas%2FPopulations%20are,or%20a%20high%20elderly%20population. [Accessed 02-01-2021]

[50] Ending systemic racism in medicine. Nature Medicine. 2020;26:985. DOI: 10.1038/s41591-020-0993-2

[51] Kuczmarski AV, Cotugna N, Mason MA, Evans MK, Zonderman AB. Depression and Cognitive Impairment Are Associated with Low Education and Literacy Status and Smoking but Not Caffeine Consumption in Urban African Americans and White Adults. Journal of caffeine research. 2015;5(1):31-41. DOI: 10.1089/jcr.2014.0019

[52] Tseng YC, Liu SH, Lou MF, Huang GS. Quality of life in older adults with sensory impairments: a systematic review. Quality of Life Research. 2018;27(8):1957-1971. DOI: 10.1007/s11136-018-1799-2.

[53] Swenor BK, Lee MJ, Varadaraj V, Whitson HE, Ramulu PY. Aging With Vision Loss: A Framework for Assessing the Impact of Visual Impairment on Older Adults. Gerontologist. 2020;60(6):989-995. DOI: 10.1093/geront/gnz117.

[54] Vu HT, Keeffe JE, McCarty CA, Taylor HR. Impact of unilateral and bilateral vision loss on quality of life. British Journal of Ophthalmology. 2005;89(3):360-3. DOI: 10.1136/bjo.2004.047498.

[55] National Academies of Sciences, Engineering, and Medicine. Health-Care Utilization as a Proxy in Disability Determination [Internet] 2018. Available from: https://www.ncbi.nlm.nih.gov/books/NBK500102/ doi: 10.17226/24969 [Accessed 02-01-2021]

[56] Sommer A, Tielsch JM, Katz J, Quigley HA, Gottsch JD, Javitt JC, Martone JF, Royall RM, Witt KA, Ezrine S. Racial differences in the

cause-specific prevalence of blindness in east Baltimore. New England Journal of Medicine. 1991;325(20):1412-7. DOI: 10.1056/NEJM199111143252004.

[57] Johnson CA, Keltner JL, Cello KE, et al. Baseline visual field characteristics in the ocular hypertension treatment study. Ophthalmology. 2002;109(3):432-7. DOI: 10.1016/s0161-6420(01)00948-4

[58] Laroche D, Nkrumah G, Ng C. Real-world efficacy of the Hydrus microstent in Black and Afro-Latinx patients with glaucoma: a retrospective study. Therapeutic Advances in Ophthalmology 2020;12 1-9.

[59] Heijl A, Leske MC, Bengtsson B, et al. Reduction of intraocular pressure and glaucoma progression: results from the Early Manifest Glaucoma Trial. Archives of Ophthalmology. 2002;120(10):1268-79. doi: 10.1001/archopht.120.10.1268.

[60] Washington DL. Charting the path from lack of insurance to poor health outcomes. Western Journal of Medicine. 2001;175(1):23. DOI: 10.1136/ewjm.175.1.23.

[61] Institute of Medicine (US) Committee on the Consequences of Uninsurance. Care Without Coverage: Too Little, Too Late. Effects of Health Insurance on Health [Internet] 2002. Available from: https://www.ncbi.nlm.nih.gov/books/NBK220636/ [Accessed 02-01-2021]

[62] Muñoz B, West SK, Rubin GS, et al. Causes of blindness and visual impairment in a population of older Americans: The Salisbury Eye Evaluation Study. Archives of Ophthalmology. 2000;118(6):819-25. DOI: 10.1001/archopht.118.6.819.

[63] HealthCare.Gov. Affordable Care Act (ACA) [Internet] 2020. Available from: https://www.healthcare.gov/glossary/affordable-care-act [Accessed 02-01-2021]

[64] Sommers BD, McMurtry CL, Blendon RJ, et al. Beyond Health Insurance: Remaining Disparities in US Health Care in the Post-ACA Era. Milbank Quarterly. 2017;95(1):43-69. DOI: 10.1111/1468-0009.12245.

[65] Kaiser Family Foundation. Changes in Health Coverage by Race and Ethnicity since the ACA, 2010-2018 [Internet] 2020. Available from: https://www.kff.org/racial-equity-and-health-policy/issue-brief/changes-in-health-coverage-by-race-and-ethnicity-since-the-aca-2010-2018/ [Accessed 02-01-2021]

[66] Varadaraj V, Frick KD, Saaddine JB, et al. Trends in Eye Care Use and Eyeglasses Affordability: The US National Health Interview Survey, 2008-2016. JAMA Ophthalmology. 2019;137(4):391-398. DOI: 10.1001/jamaophthalmol.2018.6799.

[67] Orr P, Barrón Y, Schein OD, et al. Eye care utilization by older Americans: the SEE Project. Salisbury Eye Evaluation. Ophthalmology. 1999;106(5):904-9. DOI: 10.1016/s0161-6420(99)00508-4.

[68] Greenidge KC, Dweck M. Glaucoma in the black population: a problem of blindness. Journal of the National Medical Association. 1988;80(12):1305-9.

[69] Sleath B, Blalock SJ, Carpenter DM, et al. Provider Education about Glaucoma and Glaucoma Medications during Videotaped Medical Visits. Journal of Ophthalmology. 2014;2014:238939. DOI: 10.1155/2014/238939.

[70] Population Reference Bureau. America's Aging Population [Internet] 2011. Available from: https://assets.

prb.org/pdf11/aging-in-america.pdf
[Accessed 02-01-2021]

[71] Unzueta M, Globe D, Wu J, et al. Compliance with recommendations for follow-up care in Latinos: the Los Angeles Latino Eye Study. Ethnicity & Disease. 2004;14(2):285-91.

IntechOpen

IntechOpen